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Investigating the efficacy of the use of ICT for slow learners : Case studies in Singapore Primary Schools

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Key words: *learners at risk, ICT, primary school***Abstract:**

This exploratory project investigates the implications and changes effected through the introduction of IBM's KidSmart programme into the Learning Support Programme (LSP) in 6 Singapore primary schools. It focuses on the impact of ICT on teaching and learners methodologies embraced by teachers working with slow learners (or learners at risk). The principal aim of this project is to identify workable teaching models or processes that can maximize learning through the use of ICT with slow learners. Findings indicated that all teachers interviewed used ICT actively with their learners as a support learning tool, alongside the main curriculum. Based on this, three major themes were identified which suggest how teachers can consider using ICT with slow learners to optimise learning gains.

1 Introduction

1.1 Background

The underachievement of pupils has been a persistent problem facing educators for many years. It is interesting to note that there is evidence which points out that a child's achievement and ability are not always dependent on each other, so they should be regarded as separate aspects [16, 26]. In large classes where the teacher to student ratio is high, it can be a daunting task for teachers to put slow learners in groups with uniform learning problems. Even worse, they could even be branded as nuisances, with problematic behaviour. Not very often is the teacher able to drill down to the cognitive characteristics that truly determine this group of pupils. For education or remediation interventions to work with these learners, they must aim at the very core of the problem, arising from careful testing and diagnosis [12, 30].

In Singapore, meritocracy plays a major role in determining the future success of all school leavers. In light of this, the Ministry of Education (MOE) set up the Psychological Services Branch (PSB) to assist schools in identifying and supporting pupils with special educational needs to maximise their potential. In line with this, the Learning Support Programme (LSP) provides such pupils with support in two main areas of the curriculum: English and Mathematics [19]. This programme provides primary schools with resources to help pupils who enter Primary 1 with weak English Language and literacy skills or Mathematics competencies, access the curriculum. The hope is to provide equitable access to the curriculum through ongoing-in-school support via a team of trained professionals.

Large amounts of financial and human resources are spent each year to provide computers, network technology and internet access to schools in Singapore. All of these expenditures must be well planned to maximize benefits to student achievement.

Claims have been made for the use of information and communication technology (ICT), either as a stand-alone learning support tool or alongside traditional teaching approaches, for learners at risk. Many countries, Singapore included, have adopted (ICT) as a central plank in schools for the enhancement of learning programmes to support slow learners.

At the centre, however, remain the teacher and the learner. The impact of ICT on the learning experience will depend upon the roles adopted by each, the model of the learner held by the teacher and the pedagogy adopted. Specific combinations of educational and ICT conditions including computer-use may optimise learning processes, particularly for learners at risk.

Identifying the reasons why such technology is effective or ineffective at improving pupil achievement is important. If these reasons are known, then unsuccessful situations can be modified and successful situations can be maintained. One factor associated with successful learning is motivation. It has been shown that a classroom rich with technology can be a more intrinsically motivating classroom setting than one free of technology [4]. Furthermore, the main difference between able high achievers and underachievers is that the high achievers have the motivation that enables them to be successful in a school setting. Therefore, if motivation is a key to achievement, and ICT can motivate students to learn, then having a clear understanding of the research findings regarding what elements of technology motivate us to learn seems key to best using technology in the classroom.

In addition to motivation, teacher practices with technology [23] and collaboration amongst students [5] have been identified as important elements in successful technology rich learning environments.

1.2 The IBM KidSmart Programme in Singapore

The IBM KidSmart Early Learning Programme, a community programme, started in Singapore primary schools since 2004. This programme focuses on ways to enhance early learning programmes as a necessary preparatory step in helping children to reach the highest level of their potential. IBM utilizes the most effective up-to-date hardware, software and educational materials in order to give young children who are attending early childhood settings an effective jump-start in their education. This programme is intended for not-for-profit organizations and public schools in Singapore with special interest in programmes for disadvantaged children.

More specifically, this initiative is a collaboration between IBM and Little Tikes whereby IBM donates brand new Pentium IV PCs, peripherals, children furniture and software to support public schools and not-for-profit childcare centres/kindergartens. Little Tikes custom builds colourful children furniture to hold and house the PCs and the whole unit (known as the Young Explorer unit) is donated to qualified school/centres.

Moreover, IBM adds value by conducting KidSmart training for the teachers. The objective of this is to equip them with skills to incorporate technology into early childhood education curriculum.

IBM Singapore has so far donated about 50 units of KidSmart to 24 primary schools in the Learning Support Programme (LSP) and trained 75 Learning Support (LS) teachers. This is done at the lowest possible cost to IBM by involving volunteers wherever possible.

This evaluation project is concerned with the effects of the introduction of IBM's KidSmart programme into the Learning Support Programme (LSP) of 24 Singapore primary schools. It focuses on the impact of ICT on the teachers and teaching methodologies with slow learners and the impact of the integration of ICT on learners and the process of learning. The principal aim of this project is to begin to identify teaching and learning strategies that can be used with technology as a learning support tool for slow learners within the LSP. This includes enhancing the learning, motivation and independence of such pupils.

The KidSmart unit provided by IBM involves pupils accessing the internet and software which contain instructional information in variety of forms in order to complete learning tasks. These forms include factual text information in the form of e-books, interactive simulations or micro worlds, demonstrations and drill and practice tutorials. Hence, the KidSmart computer unit can be seen as a hypermedia-based instructional learning support that utilizes the attributes and resources of the Internet and stand-alone educational software to create a meaningful learning environment where learning is fostered and supported. In this case, the teachers involved in the study used the Internet and software resources to supplement the traditional learning environment.

1.3 Research Questions

This study attempted to answer the following research questions :

1. What changes have there been in the teaching processes for the Learning Support Programme with the infusion of ICT in the classroom, using the Young Explorer Series provided by the IBM KidSmart Programme?
2. What changes have these technologies brought about in the pupils' learning processes?

1.4 Definition of terms

The term "learners at risk" in this study is taken to refer to a discrepancy between some expected level of achievement and a student's actual performance on one of more designated indices [26]. It is used interchangeably with the terms "low achievers" and "slow learners".

In the school context, Information and Communication Technology (ICT) encompasses the use of computers and its applications, the related hardware and software, the network and communication capabilities (including the use of the Internet, Intranet, email, video-conferencing and chat facilities) for teaching and learning purposes in the classroom. The focus is on the interactions among the components and how technology can be leveraged to enhance these relations to bring about engaged learning [18].

The Learning Support Programme (LSP) is an early intervention programme aimed at providing additional support in literacy skills targeted at Primary One and Two pupils who are educationally at risk [20]. All Primary One pupils are screened at the beginning of the school year to identify those who are weakest in language and literacy skills. These children are withdrawn from their mainstream. Educational psychologists, reading specialists and counsellors work together with Learning Support Co-ordinators to help these young learners.

1.5 Limitations of the study

Each school would have developed a different approach towards using the Young Explorer Series as part of their curriculum. The variety of teaching methodologies used in the LSP is not included as part of the data collected.

The nature of Singapore's existing curriculum with which teachers had to adhere to, provided some sort of limitation on the extent to which the software could be integrated into the curriculum.

Participants in this study are from government primary schools. This is a limiting factor in terms of the generalisation of the data gathered. Independent and autonomous schools operate within differing environments.

This study is limited to the investigation of perceived changes by teachers resulting from the initiatives provided by the Learning Support Programme and the IBM KidSmart Programme. Changes made by teachers that resulted from other initiatives by the school or the Ministry of Education were not included in this study.

Interview data collected was retrospective, asking teachers to recall changes made over a period of between 6 months to one year.

2 Methodology

A qualitative paradigm was used in this study. Qualitative data will be needed as this is an exploratory study, in which the context of how and why the learning activities take place is important. This type of data will help enhance the data collected. The method used for collecting the data within these two paradigms is that of a case study. An in-depth look at the learning processes of the teacher and pupil using the Young Explorer Series and the Kid Desk will be explored in detail, during a sustained period of time [14, 29].

Semi-structured interviews were conducted with teachers involved in the Learning Support Programme (LSP) that actively use the Young Explorer Series as part of their curriculum in class. These teachers and pupils in the LSP and classroom observations using the Young Explorer Series formed the qualitative portion of the study. For this, purposive sampling was done from the current pool of schools which have consented to the study. This form of sampling helped select optimally information-rich participants for in-depth exploration of the data collected from the survey.

The participants of this research were teachers from the 24 neighbourhood primary schools that had been given the KidSmart units for at least one school year. These teachers were all teaching classes involved in the Learning Support Programme in their schools in Primary One and Two. Subjects taught included English, Mathematics and Science-based lessons.

For every set of software given out to a school, two teachers were given the opportunity to attend a two day hands-on workshop. This workshop covered an orientation of the software and its accompanying manual, an overview of the use of IT for teaching and learning purposes as well as other IT tools and resources that can be used alongside the Young Explorer Series. This workshop was typically held before the software was provided to the schools. The techniques of teaching used in the demonstrations involved active modelling and

open discussions of how to carry out lesson and how accompanying problems might be resolved. With teachers from a variety of subject backgrounds and different schools present at the workshops, an incidental form of learning that occurred was a cross-curricular, interdepartmental exchange which provided additional learning opportunities.

Analysis of the qualitative data followed the process recommended by Miles and Huberman [17] comprising field notes and coding. Field notes made by the researchers during each interviews added more depth to the study's data analysis and interpretation. Theory-coding was used in the study. Through the process of inductive coding, meaningful coding structures using labels helped to set up themes. Using Boyatzis' [5] approach to coding, raw material in the interviews was highlighted for close familiarity of data captured. These were compared for similarities for the development of themes. Through an iterative process of content analysis, the activities described by the participants were organized categorically and reviewed until mega themes emerged.

3 Findings and Discussions

Dede [11], notes that the unique capabilities of computers helps support slow learners in a variety of ways. IT helps to centre the curriculum on authentic problems which parallel real world settings. It allows the involvement of students in virtual communities-of-practice to facilitate guided and reflective inquiry. Educators can use computer software in modelling and visualization to bridge experience and abstraction to enhance students' collaborative construction of meaning.

In support of this, all teachers who responded to the survey said that they used the KidSmart unit on a regular basis, as part of their teaching tools in the classroom, from a frequency of everyday to at least once a month. On an average, students used the KidSmart unit for a time span of 15 to 30 minutes at a time within each lesson.

In the interviews, all teachers noted that ICT increased student motivation and developed the skills or strategies to make their pupils more competent. Teachers were also able to structure their learning environment so that pupils were able to take ownership of their own learning.

One necessary condition for the advancement of low achieving students into higher study streams is a change in teaching methods in order to shift the emphasis from transfer of information to meaningful use of acquired knowledge [1]. In the telephone interviews, teachers were quite candid about the fact that they themselves had undergone a paradigm shift in using the KidSmart unit to help their students learn better. One teacher noted how she did not have time to work with individual students as much as she liked. However, with the computer in the classroom, she was able to pull up resources from the Internet & craft online tasks & corresponding worksheets for individualised learning, even during group work. Another teacher pointed out that she had to first go through the activities she had designated for her students before giving it to them. This meant more preparation time but felt it was worthwhile upon seeing how motivated her students were in working through the tasks the computer provided them. Both these teachers were quick to point out that they would not have thought of providing such differently structured lessons if the KidSmart unit had not been given to them in their classrooms.

3.1 *Recurrent Themes in the study*

Computers enable real interaction between students and intelligent sophisticated tools. A student can use the computer in a range of ways, including design, drawing and innovating. The added value is in the opportunity given to students to deal with 'real' subjects, to build or create a product that touches their daily life and to derive immediate benefit from it. The perception that one must first impart general knowledge which students can then use for further study has been particularly unsuccessful with low achieving students [4]. Technology enables students to try out a range of tasks of different cognitive levels. A free and continuous transition is possible between practical activities, concrete and formal reasoning. This enables students to try out a systematic presentation of problems, presentation and testing of different solutions, distinction between theory' and practice, and awareness of mistakes.

Three recurrent themes appeared from the data analysis: objectivism vs. constructivism teaching frameworks; fixed vs. flexible learning models and teacher vs. coach roles in the classroom.

3.1.1 *Objectivism vs. constructivism teaching framework*

Objectivism has dominated the field of education for several years. Most traditional approaches to learning and teaching that are based on behaviourist and cognitive theories share philosophical assumptions that are fundamental in objectivism. Objectivism refers to the creation of performance objectives & programmed instruction following stages to guide instruction & evaluation of learners [28]. This framework emphasizes passing knowledge from teacher to learner which in turn, can promote passive learning. There is one correct understanding of any topic. Learning is defined as a change in behaviour and/or the learner's cognitive structures. Therefore, instruction should be designed to effectively transfer the objective knowledge in the learner's head. Tyler [25], developed a model based on the objectivist paradigm. His approach consists of four major steps which are fixed and must be followed in this sequence: Identify objectives of instruction → Select useful learning experiences → Organize learning experiences → Evaluate learning. Based on this model, instructional objectives should always match the learning experiences and evaluation component. The objectives will drive the whole curriculum development process.

On the opposite end of the continuum is constructivism. The basic and most fundamental assumption of constructivism is that knowledge does not exist independent of the learner but knowledge is constructed. Constructivism focuses on learners with the goal of helping them construct meaning from experience through information-rich and socially meaningful learning environments [16]. Meaning is a result of an interpretive process and it depends on the knower's' experiences and understanding [21].

The teachers interviewed noted that their teaching frameworks had to change to accommodate the infusion of ICT in their lessons. This change meant that they could no longer dictate accurately the learning outcomes of their students but needed to be more flexible in allowing their pupils craft their learning goals, in line with the overarching instructional goals that had been planned for the lesson. Hence, these teachers needed to realise that as the ICT-mediated lesson progressed, knowledge was being constructed in the heads of their pupils while they were re-organizing their experiences and cognitive structures. A summary of sub-themes and supporting statements is presented in Table 1.

Changes noted in teaching framework	Supporting Statements from participants
Learning via variation	<ul style="list-style-type: none"> • "...my pupils now can learn by viewing the visuals and simulations on the net..." • "...after I teach, I give them the freedom to view sites on the Internet Likeshort movie clips ...like Brain Pop..."
Inductive Teaching	<ul style="list-style-type: none"> • "My pupils can come up with better examples & making connection between what they have learnt...." • "I let them explore software dealing with the concept I want to teach before conducting the formal lesson. This makes my teaching slightly easier ..."
Multiple means of engagement / motivation	<ul style="list-style-type: none"> • "...I can tap into my pupils' interest through different means on the computer." • "The software has different levels so my pupils can be challenged at the next level..." • "The pupils love being on the computer. They even said they should appear stupid so they can spend more time on the computer." • "...they have funand learn at the same time ...it's so nice to see them smiling .."

Table 1 : Summary of supporting statements on Teaching Framework

Constructivism is of the view that learning involves meaning-making. Learners create meaningful interpretations of what they are learning. Therefore, the goal of constructivist educators is to guide students to think and act like experts [22]. This leads to the next emergent theme, that of the teacher now playing the role of a coach in class.

3.1.2 Teacher-centred vs. student-centred learning environments

ICT is believed to contribute to innovative, pupil-centred learning environments. In these environments, curriculum characteristics fit pupil characteristics better and teachers act as coaches instead of lecturers. Much of traditional teaching is teacher-centred and teacher-controlled. Coaching implies a teacher who observes learners as they work on a learning task, offering hints, scaffolding, feedback, modelling and reminders aimed at improving their learners' performance [8]. Implicit here is the constructivist assumption that learners are responsible for constructing their own knowledge, but are assisted by a knowledgeable and more experienced guide. In this respect, the teacher plays the role of a facilitator who aids the learning process through the creation of authentic tasks to assist learners integrate their understanding of multiple perspectives through reflection and experiential learning models. This allows the teacher room to provide for decision making by the children. Students can choose how they want to interact with the software, and thus, learn independence at an early age. However, teachers still need to facilitate this learning process by providing guidance to their students on which software to use. Table 2 gives a short summary of participant's feedback on changes noted in their learning environments.

Changes noted in learning environments	Supporting Statements from participants
Learner empowerment	<ul style="list-style-type: none"> • "...my pupils now can learn by viewing the visuals and simulations on the net..." • "...after I teach, I give them the freedom to view sites on the Internet Likeshort movie clips ...like Brain Pop..."
Enrichment / extension of the curriculum	<ul style="list-style-type: none"> • "Pupils go through discovery....they learn by doing things on their own at the computer..." • "...they start to see things in a bigger contextthis helps broaden their perspective on concepts ..."

Table 2 : Summary of supporting statements on learning environments

3.1.3 Fixed vs. ICT-mediated Flexible Learning Processes

A flexible learning model involves the shift from knowledge being fixed to a certain time and place to knowledge that is accessible anytime, anyplace, and at any pace [30]. A flexible learning model allows students to create the potential for a change in the way learning is transacted from those who provide information (teachers) to those who receive it (students). Flexible learning models often involve student-centred, autonomous learning [13]. Flexible learning aims to encourage deep approaches to learning, primarily through a wider range of interactions and guided experiential activities using action learning and reflective practice.

Beattie and James [3] distinguished four categories of flexible learning activities: real-time teacher-pupil interaction; computer-mediated interaction; pre-packaged learning resources and guided experimental activities.

This was seen to be provided to teachers in the form of ICT-mediated activities, such as the use of online simulations, games and quizzes.

Changes noted in learning processes by pupils	Supporting Statements from participants
Application of previous knowledge learnt	<ul style="list-style-type: none"> • "They can re-use what they learnt in a previous lesson to work through a game..." • "I don't have to recall what was taughtthe software helps me with that ..."
Application of critical thinking processes	<ul style="list-style-type: none"> • "...the pupils get engrossed in winning at a game that they forget they are learning while on the computer" • "...the computer can creatively tap on their thinking skills for me as a teacher ..."

Table 3 : Summary of supporting statements on learning processes

4 Conclusion

This paper looked at how teachers can begin to have more ICT-mediated lessons with learners at risk. It is a beginning point for understanding how teachers' perceptions' and mental models regarding teaching and learning need to change to accommodate the affordances of ICT in the classroom. It is the hope that with the infusion of technologies into the classroom, teachers can best use ICT for optimal results.

Barriers exist towards the infusion of technology into the classroom. Teachers are not always willing, able, or comfortable with modifying their instructional strategies to accommodate slow learners. With this in mind, teachers can now use new technologies to look at learning problems in many different ways: to make new connections to create new approaches to learning, including student-centred and active-learning models that encourage students to solve meaningful problems and reflect on their thinking processes. Figure 1 offers a summary of how these changes can take effect.

It is imperative that all teachers realize that technology can contribute to the learning of pupils at risk in several ways [2]. With the fear of failure, pupils may feel hesitant keep trying. Technology can help these pupils transfer knowledge from one learning experience to another, for example, from speech sounds to written symbols through drill and practice software, without the fear of anyone looking over their shoulders to critique their progress.

Technology can also offer the slow learner the ability to move at his or her own pace. Large or complex tasks can be broken into components. Levels in games and quizzes give learners the chance to explore and discover new levels of meaning incrementally along the way. The teacher can even use this as a form of reinforcement or remediation to help learners with their progress of difficult concepts.

Even in smaller, more controlled classes, slow learners can feel overwhelmed at the pace of the lesson. ICT empowers the learner to move at his comfortable speed, reviewing or fast-forwarding as he/she chooses. This builds up confidence and independent learning skills. Learners who gain competency with technology, experience higher levels of self-esteem as they are able to complete a task they previously were unable to accomplish.

Feedback, correction of simple errors, and the reward of achievement of goals are essential for learning and skill building. Technology can provide immediate and continual feedback pupils desire and which facilitates learning. ICT provides multi-sensory approaches to learning. This was noted by teachers when they had their pupils learn through simulations or e-books online.

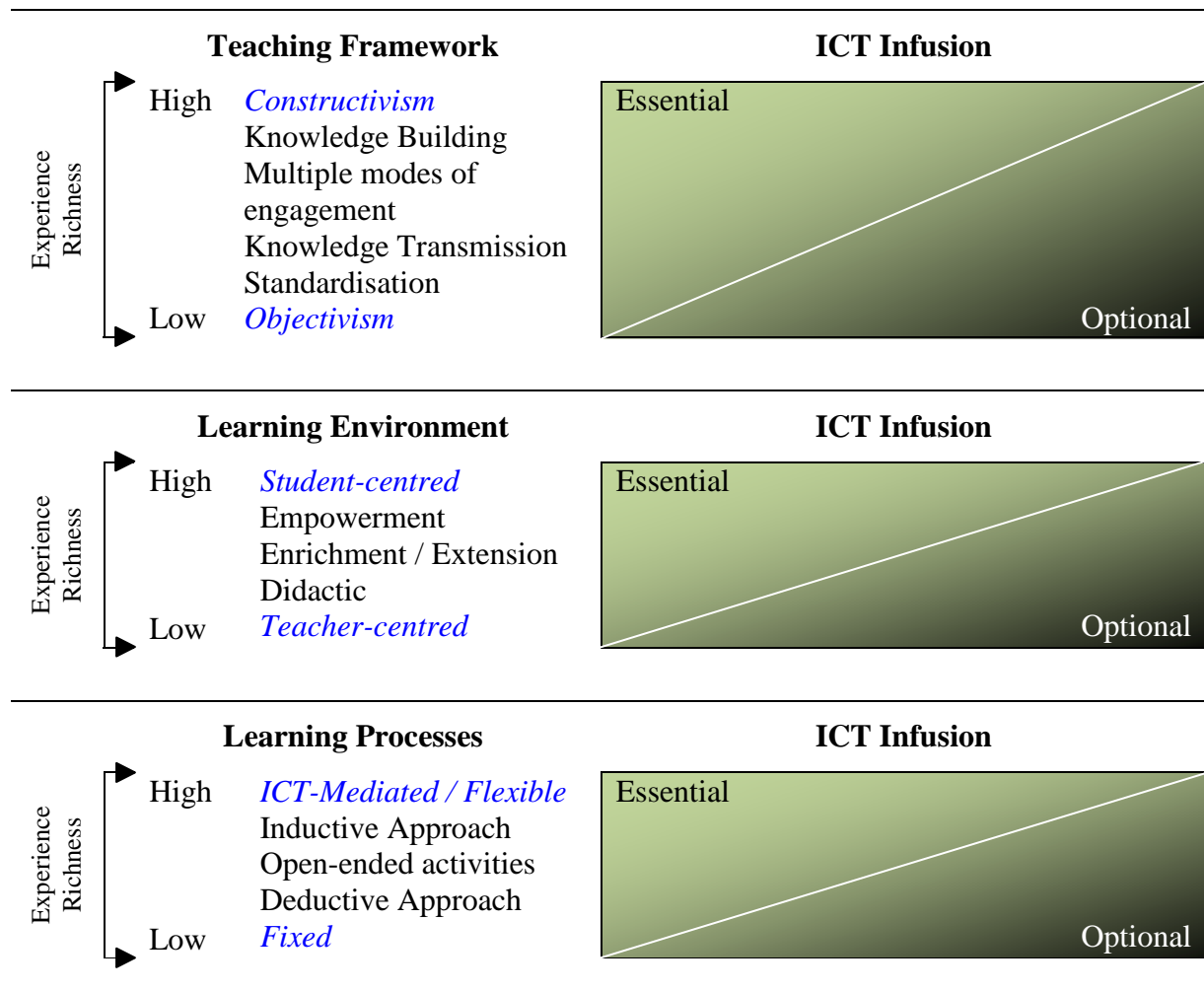


Figure 1 : Summary of changes of teaching and learning for ICT-mediated lessons

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